Moving Students from the Red Zone in Math

2019 GED Annual Conference

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WELCOME!

In this session, we will

- *Discuss challenges that higher-level Adult Basic Education students have in mathematics*
- *Review strategies and activities to help students improve their basic math skills and consistency in using those skills*
- *Share ideas and resources*

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Understanding Skills Students Have

Low Intermediate Basic Education (4-5.9 GLE)	High Intermediate Basic Education (6-8.9 GLE)	Low Adult Secondary Education (9-10.9 GLE)
Students can perform with high accuracy all four basic math operations using whole numbers up to three digits and can identify and use all basic mathematical symbols.	Students can perform all four basic math operations with whole numbers and fractions; can determine correct math operations for solving narrative math problems and can convert fractions to decimals and decimals to fractions; and can perform basic operations on fractions.	Students can perform all basic math functions with whole numbers, decimals, and fractions; can interpret and solve simple algebraic equations, tables, and graphs and can develop own tables and graphs; and can use math in business transactions.

Three Score Level Indicators on GED Ready®

Not Likely to Pass	Too Close to Call	Likely to Pass
100-133	134-144	145-200

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Test-taker Scoring Too Close to Call

The Student's performance

- Is typically based on a test-taker's consistency in demonstrating skills, or
- May be based on the level of complexity of materials that a test-taker can handle
  - Lower-performing students may be
    - Successful with simpler materials and
    - Less successful with those that are more complex

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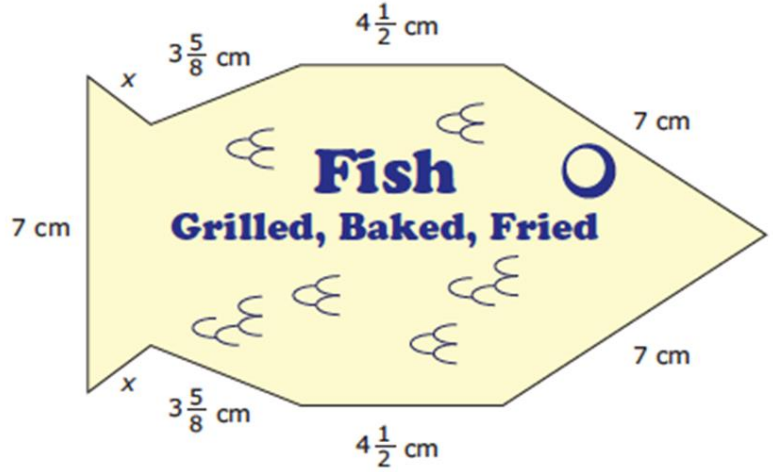
Is There An Example?

High Impact Indicator – Q4
Calculate dimensions, perimeter, circumference, and area of two-dimensional figures

Skills Being Measured
- Understanding of the definition of perimeter
- Using reasoning skills to determine the value of *x*
  - Including estimation skills

A painter uses the outline of a fish on a restaurant sign. The perimeter of the outline is $40\frac{3}{4}$ centimeters (cm).



What is the missing length, *x* cm, of the outline?

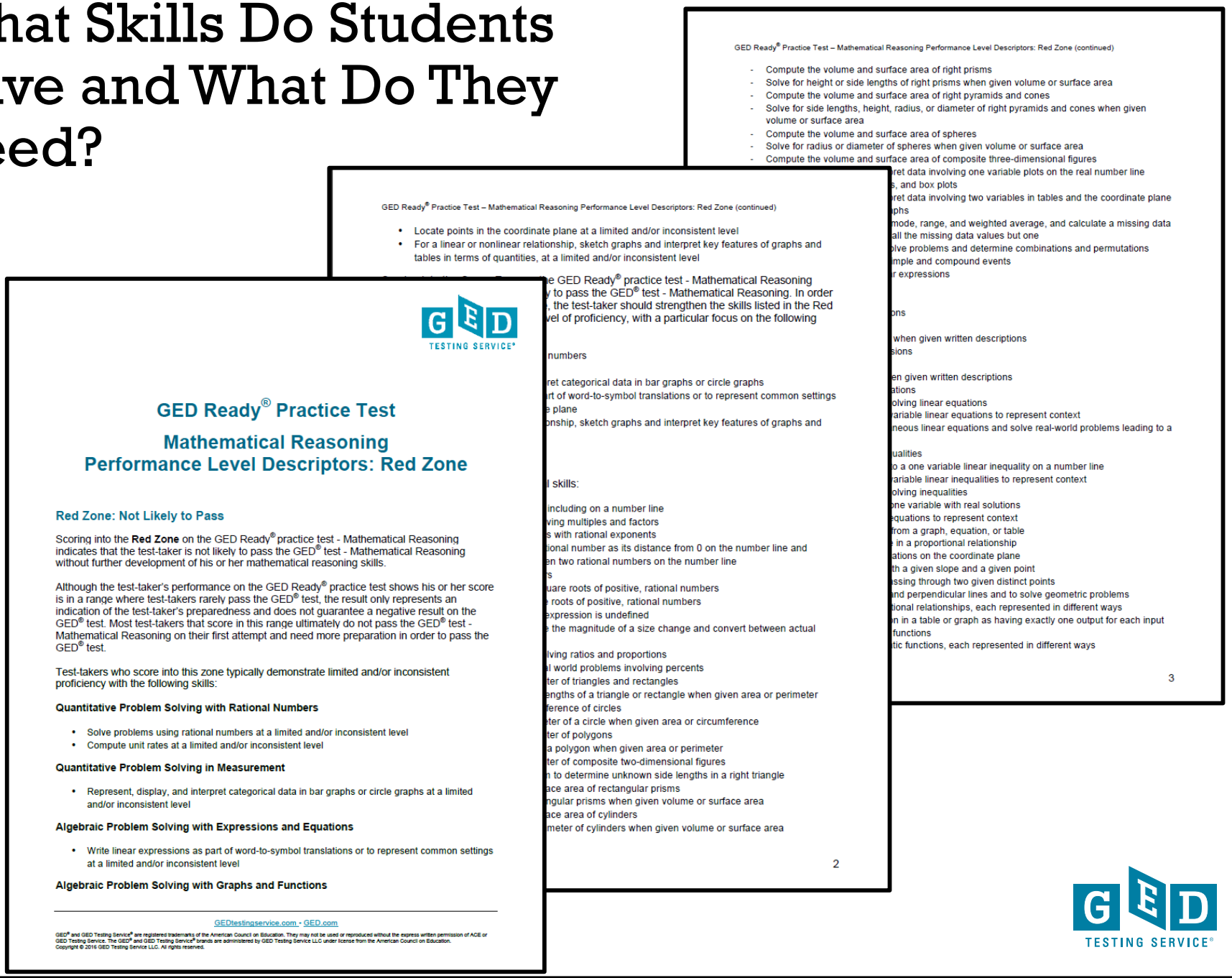
Ⓐ $\frac{7}{8}$

Ⓑ $1\frac{3}{4}$

Ⓒ $3\frac{1}{2}$

Ⓓ $5\frac{1}{4}$

What Skills Do Students Have and What Do They Need?



GED Ready® Practice Test – Mathematical Reasoning Performance Level Descriptors: Red Zone (continued)

- Compute the volume and surface area of right prisms
- Solve for height or side lengths of right prisms when given volume or surface area
- Compute the volume and surface area of right pyramids and cones
- Solve for side lengths, height, radius, or diameter of right pyramids and cones when given volume or surface area
- Compute the volume and surface area of spheres
- Solve for radius or diameter of spheres when given volume or surface area
- Compute the volume and surface area of composite three-dimensional figures

3

GED Ready® Practice Test – Mathematical Reasoning Performance Level Descriptors: Red Zone (continued)

- Locate points in the coordinate plane at a limited and/or inconsistent level
- For a linear or nonlinear relationship, sketch graphs and interpret key features of graphs and tables in terms of quantities, at a limited and/or inconsistent level

2

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GED Ready® Practice Test

Mathematical Reasoning
Performance Level Descriptors: Red Zone

Red Zone: Not Likely to Pass

Scoring into the **Red Zone** on the GED Ready® practice test - Mathematical Reasoning indicates that the test-taker is not likely to pass the GED® test - Mathematical Reasoning without further development of his or her mathematical reasoning skills.

Although the test-taker's performance on the GED Ready® practice test shows his or her score is in a range where test-takers rarely pass the GED® test, the result only represents an indication of the test-taker's preparedness and does not guarantee a negative result on the GED® test. Most test-takers that score in this range ultimately do not pass the GED® test - Mathematical Reasoning on their first attempt and need more preparation in order to pass the GED® test.

Test-takers who score into this zone typically demonstrate limited and/or inconsistent proficiency with the following skills:

Quantitative Problem Solving with Rational Numbers

- Solve problems using rational numbers at a limited and/or inconsistent level
- Compute unit rates at a limited and/or inconsistent level

Quantitative Problem Solving in Measurement

- Represent, display, and interpret categorical data in bar graphs or circle graphs at a limited and/or inconsistent level

Algebraic Problem Solving with Expressions and Equations

- Write linear expressions as part of word-to-symbol translations or to represent common settings at a limited and/or inconsistent level

Algebraic Problem Solving with Graphs and Functions

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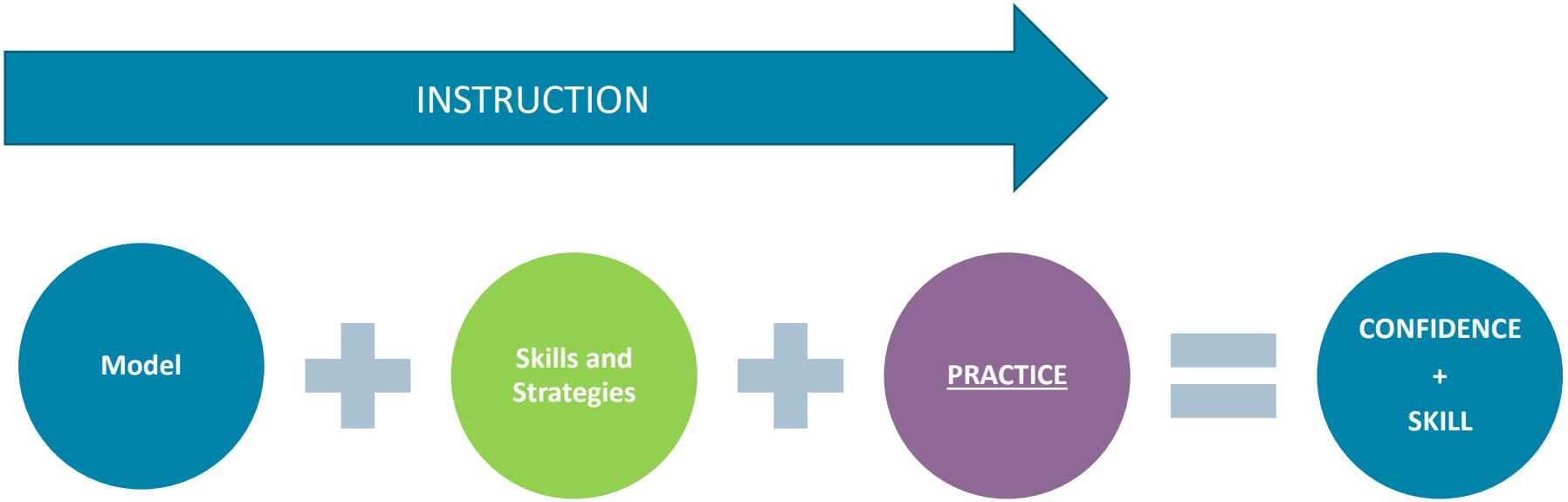
So…How Can You Help Students Move Out of the Red Zone?

Building Better Math Skills



Before Diving In…

A short reminder about the importance of *math skills*…

Math…

- Is good for your brain
- Makes you a better problem-solver
- Is used in practically every career in some way
- Is all around you and helps you understand the world better

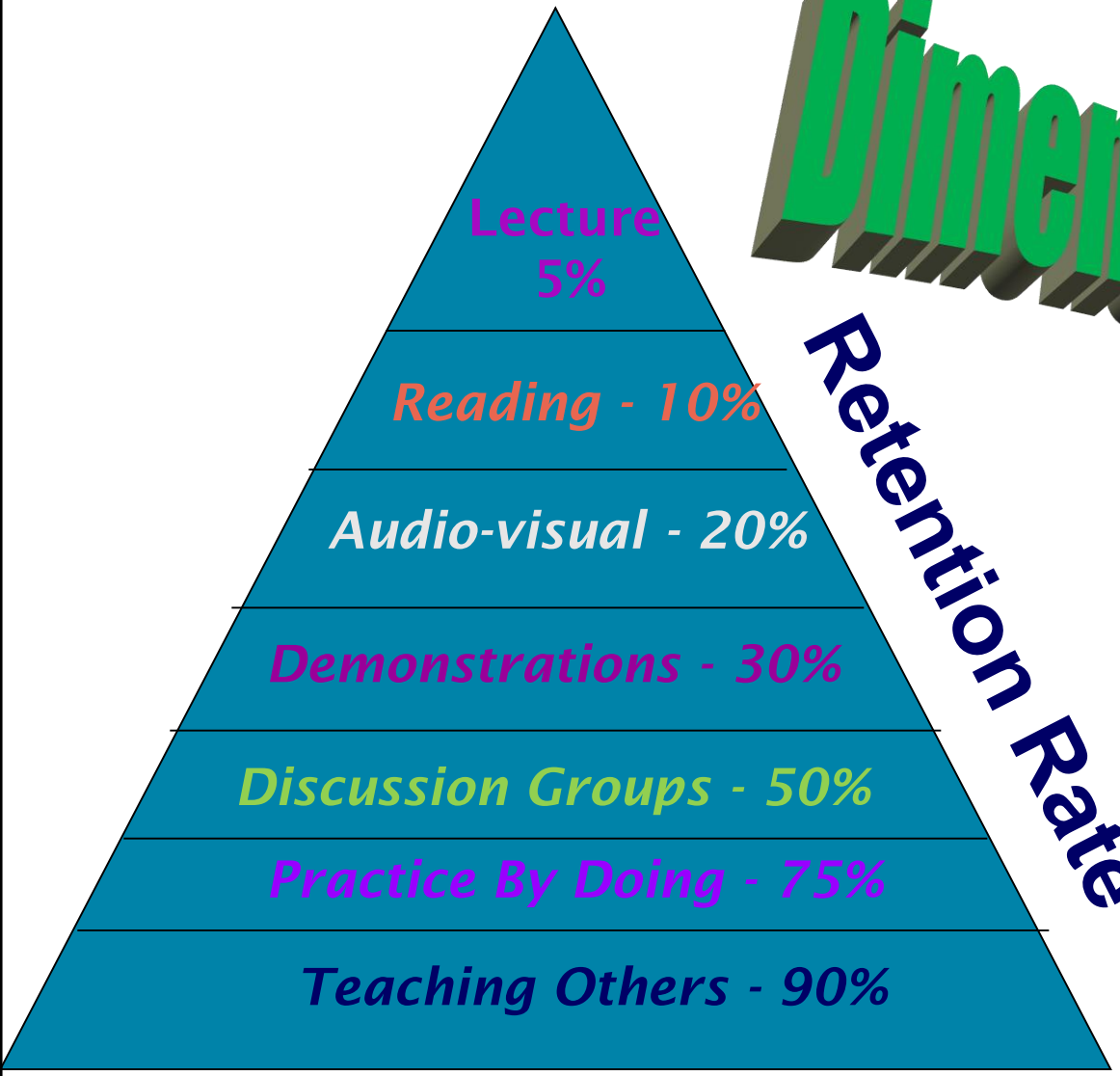
And then there is…

Mathematically proficient students…

- Explain to themselves the meaning of a problem and look for entry points to its solution.
- Make sense of quantities and their relationships in problem situations.
- Use assumptions, definitions, and previously established results to construct arguments.
- Apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.
- Consider all available tools when solving a mathematical problem.
- Communicate precisely to others.
- Look closely to discern a pattern or structure.
- Notice if calculations are repeated and look for general methods and shortcuts.

NCTM - Standards for Mathematical Practice

Dimensions of Learning



National Training Laboratories, Bethel, Maine

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Advice

Learn How Students Feel and Think about Math

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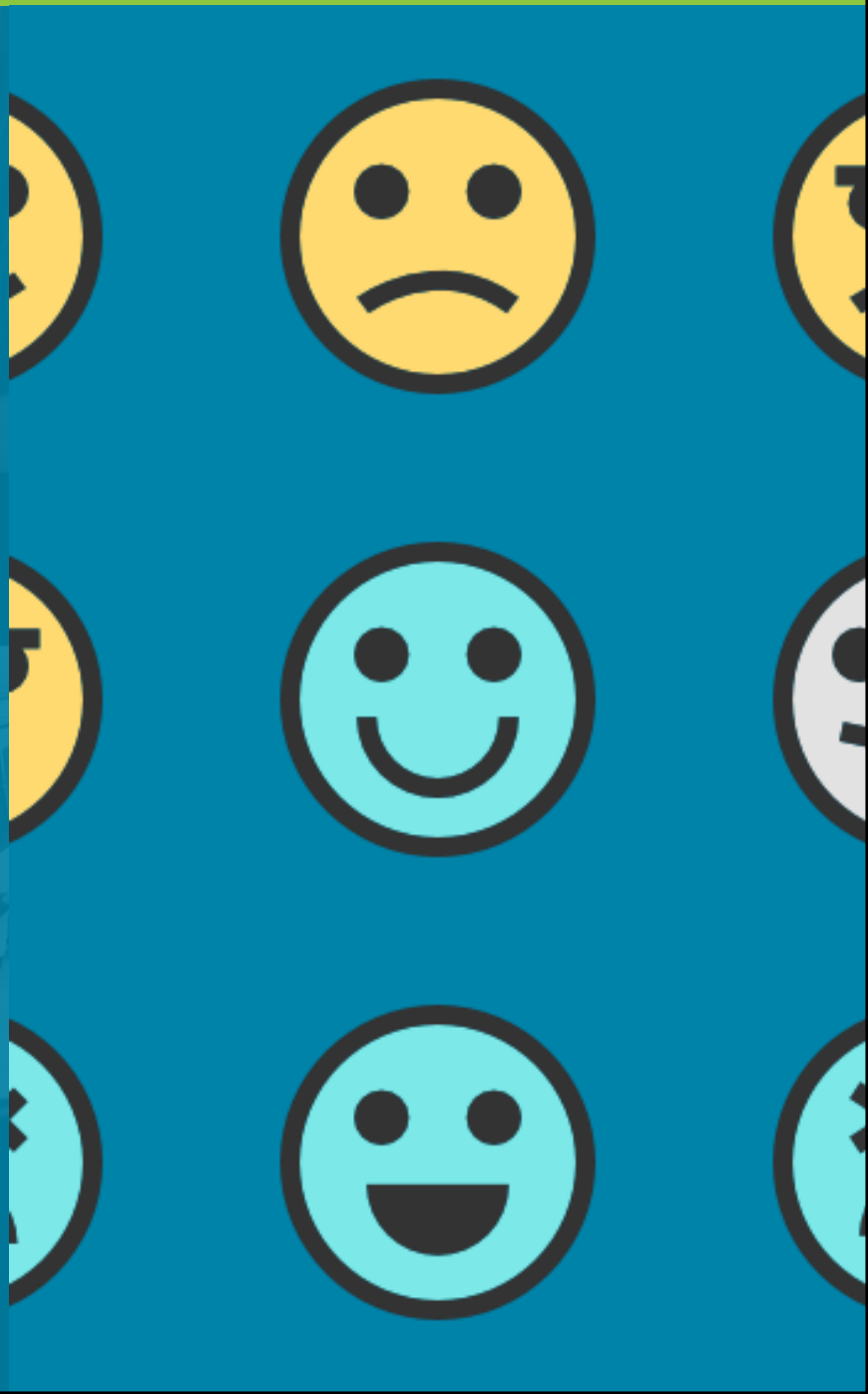

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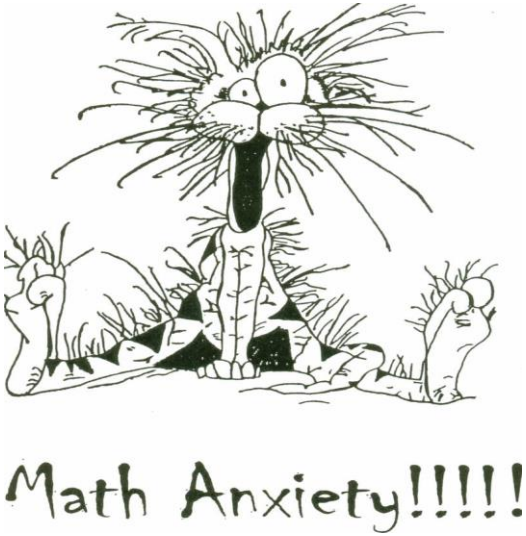
Math Journals Help Students

- Be aware of what they do and do not know
- Make use of prior knowledge
- Identify their mathematical questions
- Develop their ability to problem solve
- Monitor their own progress
- Make connections
- Communicate more precisely
- Express their feelings about math
- Let you know what they are doing and why



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Three Types of Prompts

- **Affective/attitudinal** prompts, which focus on how students feel
- **Mathematical content** prompts, which focus on what the material is about.
- **Process** prompts, which require students to explain what they are thinking and doing

- One secret I have about math is…
- If I become better at math, I can…
- My best experience with math was when…
- My worst experience with math was when…

- What patterns did you find in…?
- How do you use … in everyday life?
- Explain in your own words what … means.
- One thing I have to remember with this kind of problem is…

- What would happen if you missed a step in the problem? Why?
- What decisions did you have to make to solve this type of problem?
- When I see a word problem, the first thing I do is…

It's Your Turn!

One secret I have about math is . ..

My best experience with math was when . . .

My worst experience with math was when . . .

What Can You Do?

Incorporate Writing in Math

- Math Autobiography
- Learning Log, journal
  - What you did
  - What you learned
  - What you are not sure about
  - Explain the steps, new words
- Freewriting
- Explain mathematical ideas
- Explain the details

Set the Stage for Positive Writing

- Make early activities easy
- Explain why students are writing
- Facilitate by guiding students as they learn how to think through and communicate their thoughts
  - Model the process
  - Allow ample time
  - Provide feedback

Advice

Help Students Think Differently

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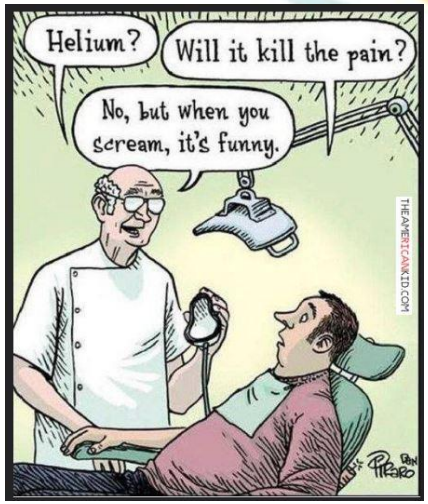
"Students often enter a math class with about as much enthusiasm as one brings to a root canal procedure."

— Gary Stogsdill, Mathematics Professor
Prescott College, Arizona



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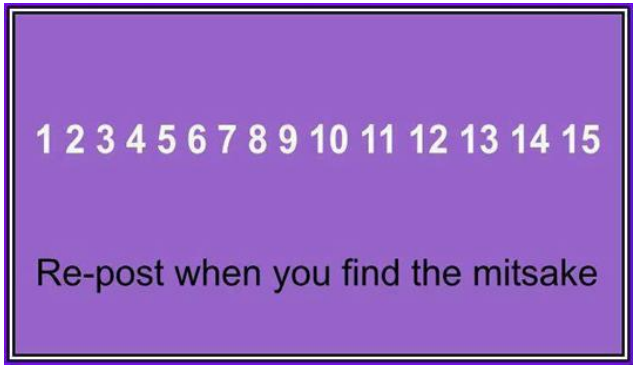
Use Brainteasers to Develop Reasoning Ability

- Engages students' minds in a reasoning process
- Encourages students to play and have fun
- Uses humor to increase interest and motivation
- Decreases math anxiety
- Focuses on reasoning – not just the answer



"Brainteasers are therapy for the mind."

Stogsdill, Gary. "Being Reasonable: Using Brainteasers to Develop Reasoning Ability in Humanistic Mathematics courses," Journal of Humanistic Mathematics, Volume 4 Issue 2 (July 2014).

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It's Your Turn!

A little boy goes shopping and purchases 12 tomatoes. On the way home, all but 9 get mushed and ruined. How many tomatoes are left in a good condition?

Nine

Eggs are $0.12 a dozen. How many eggs can you get for a dollar?

100 eggs, at one penny each

The Diophantus Riddle

Diophantus' youth lasted one sixth of his life. He grew a beard after one twelfth more. After one seventh more of his life, he married. 5 years later, he and his wife had a son. The son lived exactly one half as long as the father, and Diophantus died four years after his son.

How many years did Diophantus live?

The Father of Algebra

Thanks Diophantus!!!

Here is an equation to reflect the several ages of Diophantus:

$(1/6)x + (1/12)x + (1/7)x + 5 + (1/2)x + 4 = x$

Solve that equation and the solution is x = 84 years.

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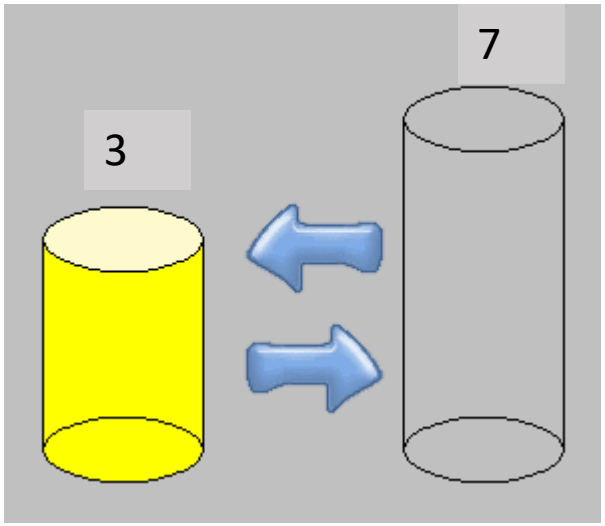
If at first you don't succeed…



You are standing by the duck pond with two pails. One holds 7 gallons and the other holds 3 gallons. Neither one of them has gallon markings on the side. How can you get exactly 5 gallons of water in the big pail?

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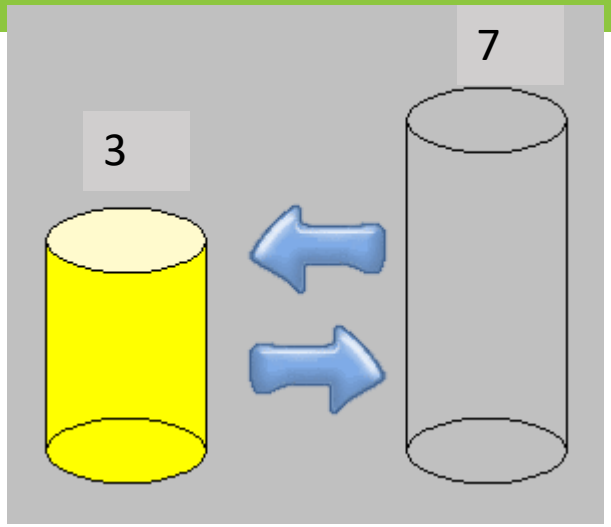
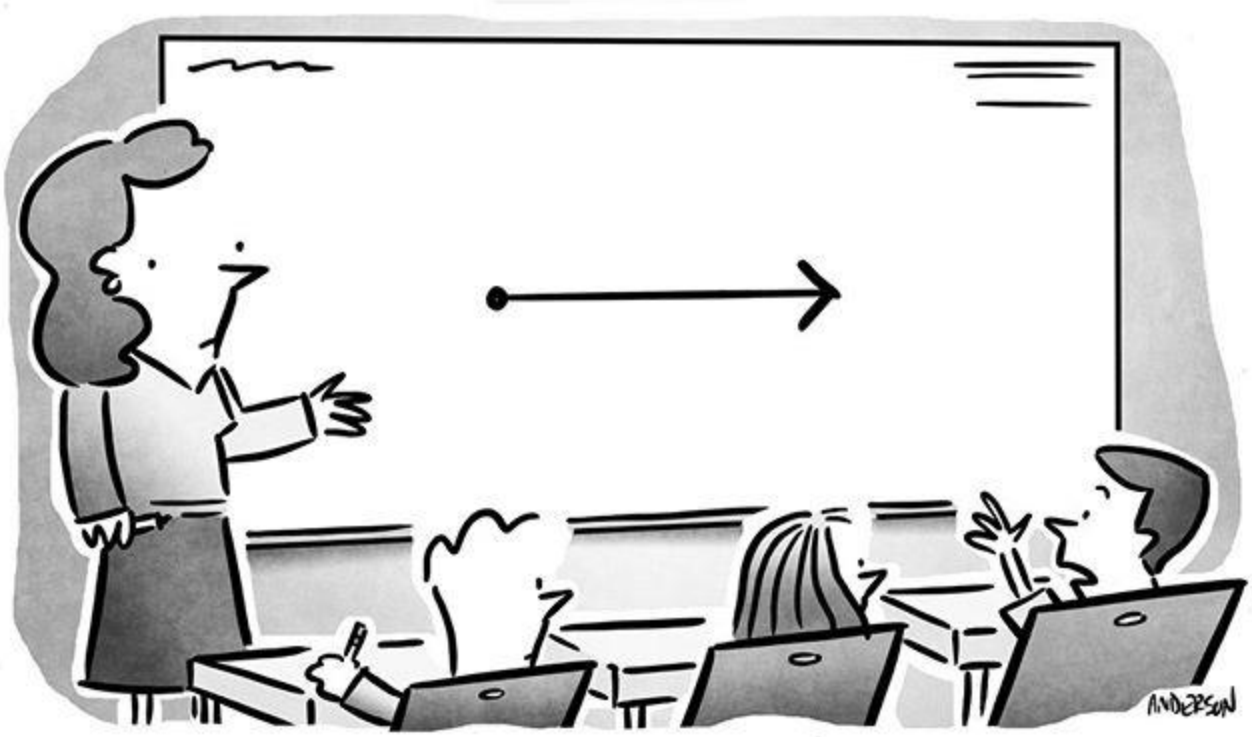
Solution



Fill 3; dump it into 7.
Fill 3; dump it into 7, which now has six gallons in it.
Fill 3; dump one gallon into 7 (you can do this, since it makes 7 full).
The 3 now has two gallons left in it.
Empty 7 completely; pour the two gallons from 3 into 7.
Fill 3; pour it into 7.
The 7 now has five gallons in it.



"So that goes on forever? Should we warn people in the hallway?!"

Advice

Help Students Build Math Vocabulary

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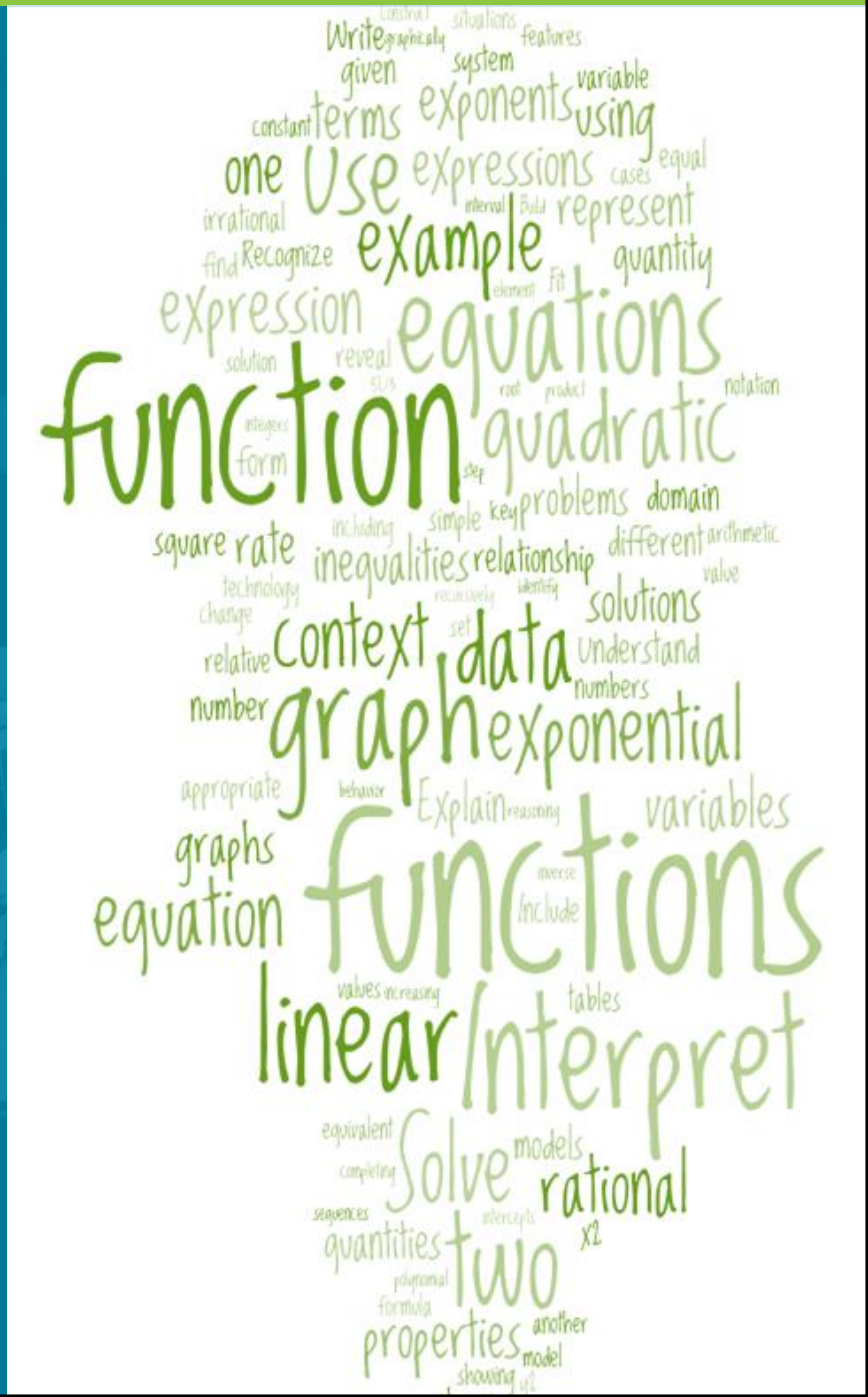

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What if the Words were Missing?

Mathematical Reasoning - Candidate Name — Question 5 of 10

Answer Explanation | Calculator | Flag for Review

A scientist is studying red maple tree growth in a state park. She measured the trunk diameters of a sample of trees in the same month every other year. The tables show the data for two of the trees.

Tree 1

Year	Trunk Diameter (inches)
1	18.6
3	19.2
5	19.8
7	20.4
9	21.0
11	21.6
13	22.2

Tree 2

Year	Trunk Diameter (inches)
1	11.4
3	12.0
5	12.6
7	13.2
9	13.8
11	14.4
13	15.0

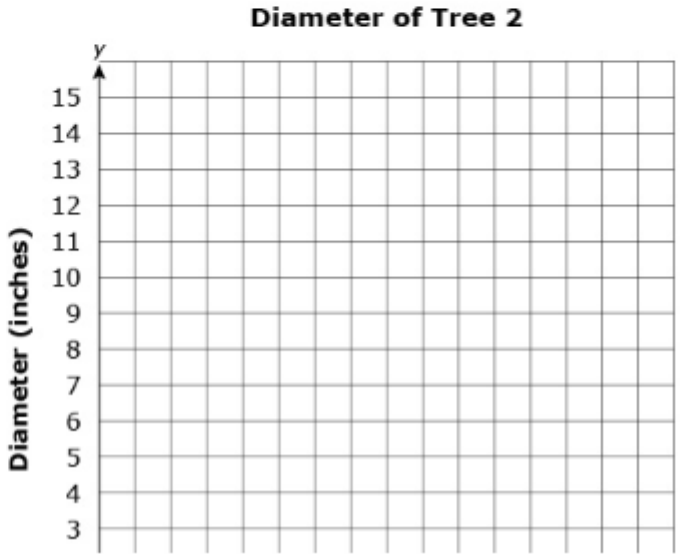
This is the final year in which she will collect data. When her data collection is complete, she will predict future red maple tree growth.

Formula Sheet | Calculator Reference

The scientist plots the data for tree 2 on a coordinate grid. She begins by plotting data for year 3 and year 11. What are the locations of the two points on the coordinated grid?

Click on the grid to plot the points

(Note: To remove a point, place the arrow over the point and click the left mouse button.)



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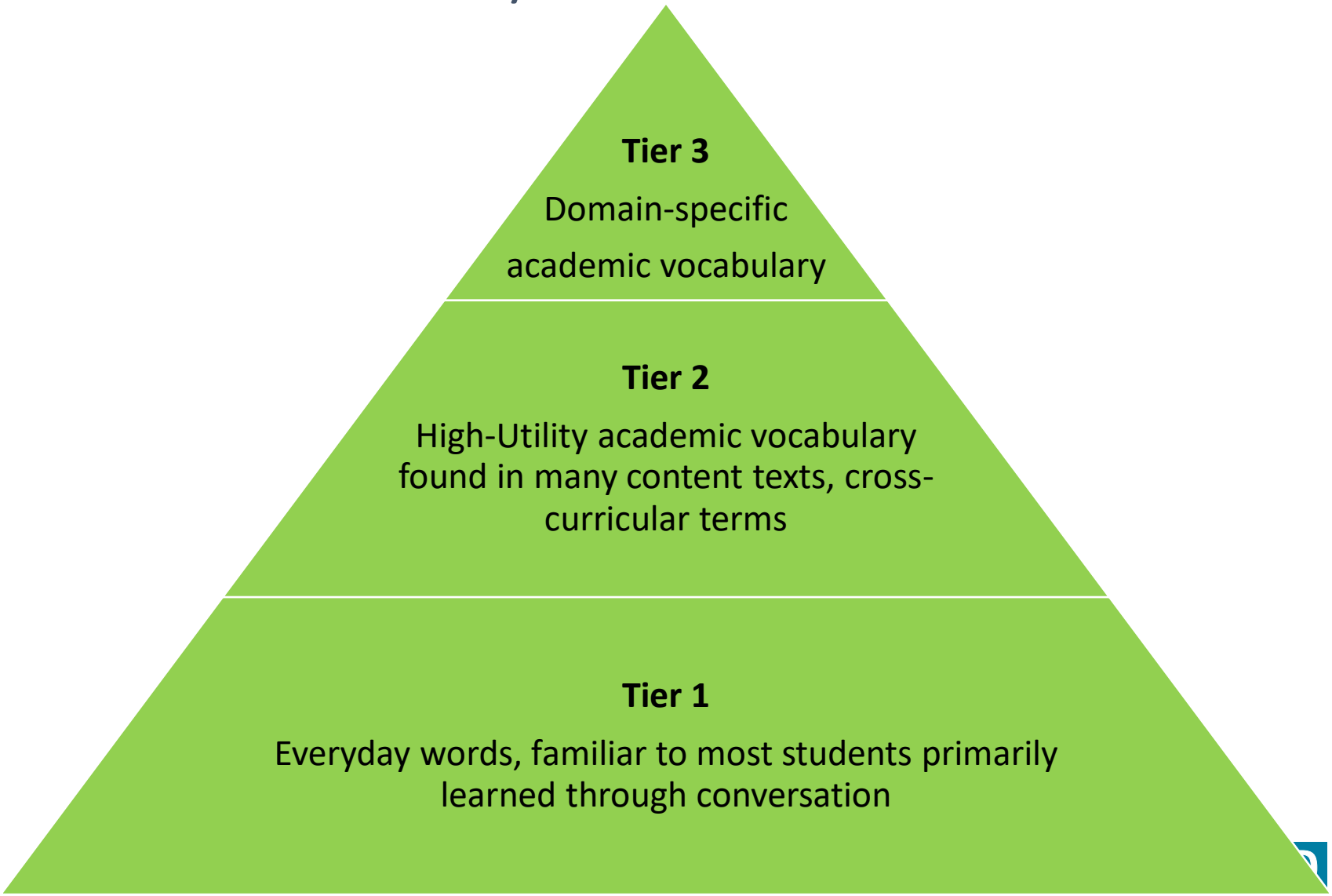
Tiered Vocabulary



Do Your Students Know These Words?

Tier 2 Vocabulary Words Students May Encounter in Math

Analyze	Compare	Contrast
Demonstrate	Describe	Argument
Conclusions	Evidence	Determine
Develop	Evaluate	Explain
Identify	Infer	Draw
Distinguish	Suggest	Interpret
Organize	Illustrations	Predict

http://soltreemrls3.s3-website-us-west-2.amazonaws.com/marzanoresearch.com/media/documents/reproducibles/vocab-common-core/sourcelistforpartIIandIIIterms.pdf

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How About These Words?

Tier 3 Math Vocabulary Words

Absolute value	Additive inverse	Algorithm
Attribute	Constant	Distance formula
Exponent	Function	Dependent variable
Independent variable	Linear	Numerical expression
Profit	Property	Proportional gain
Rate of change	Strategy	Value

http://soltreemrls3.s3-website-us-west-2.amazonaws.com/marzanoresearch.com/media/documents/reproducibles/vocab-common-core/sourcelistforpartIIandIIIterms.pdf

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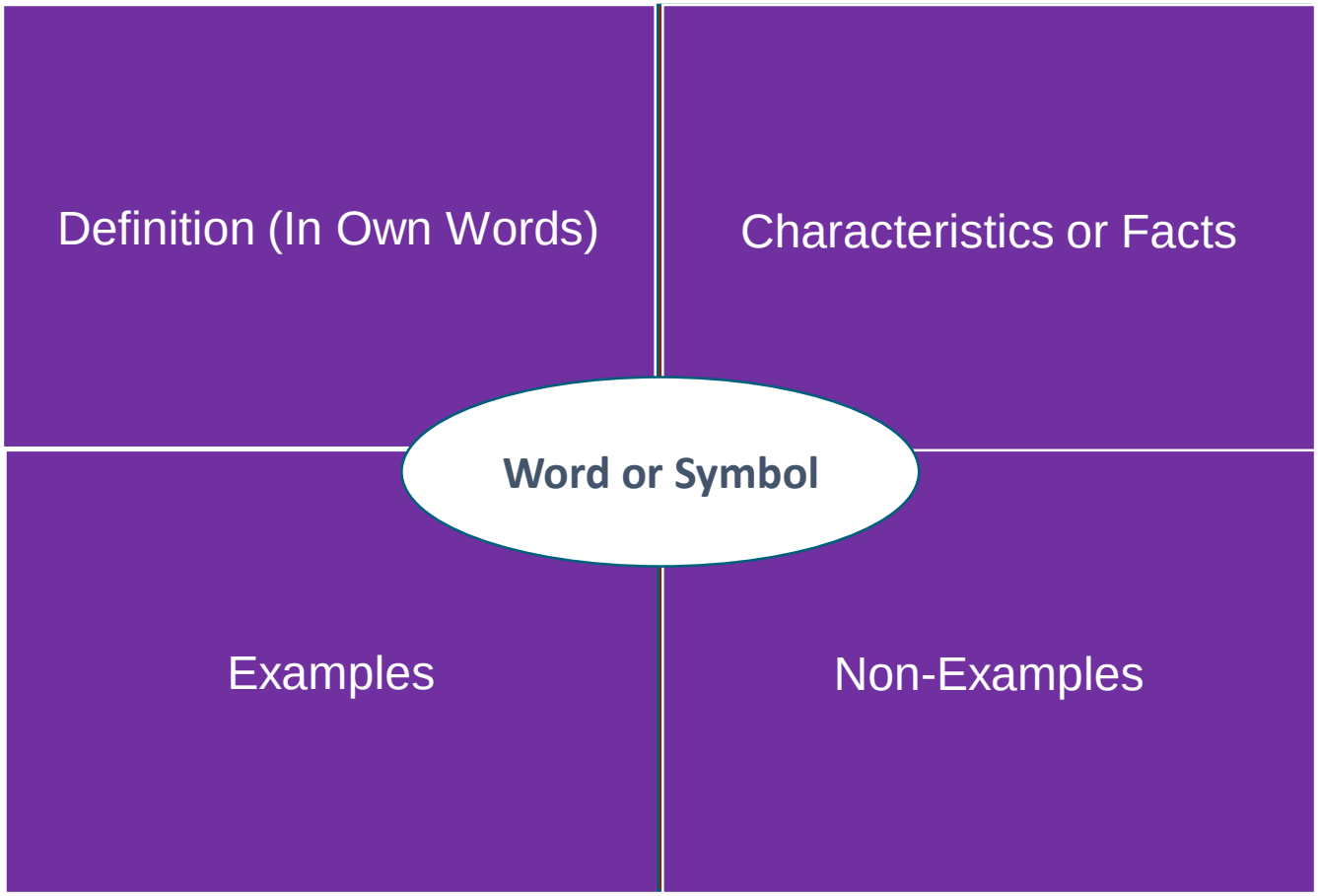
Building Vocabulary



Frayer Model – (Barton and Heidema, 2002)

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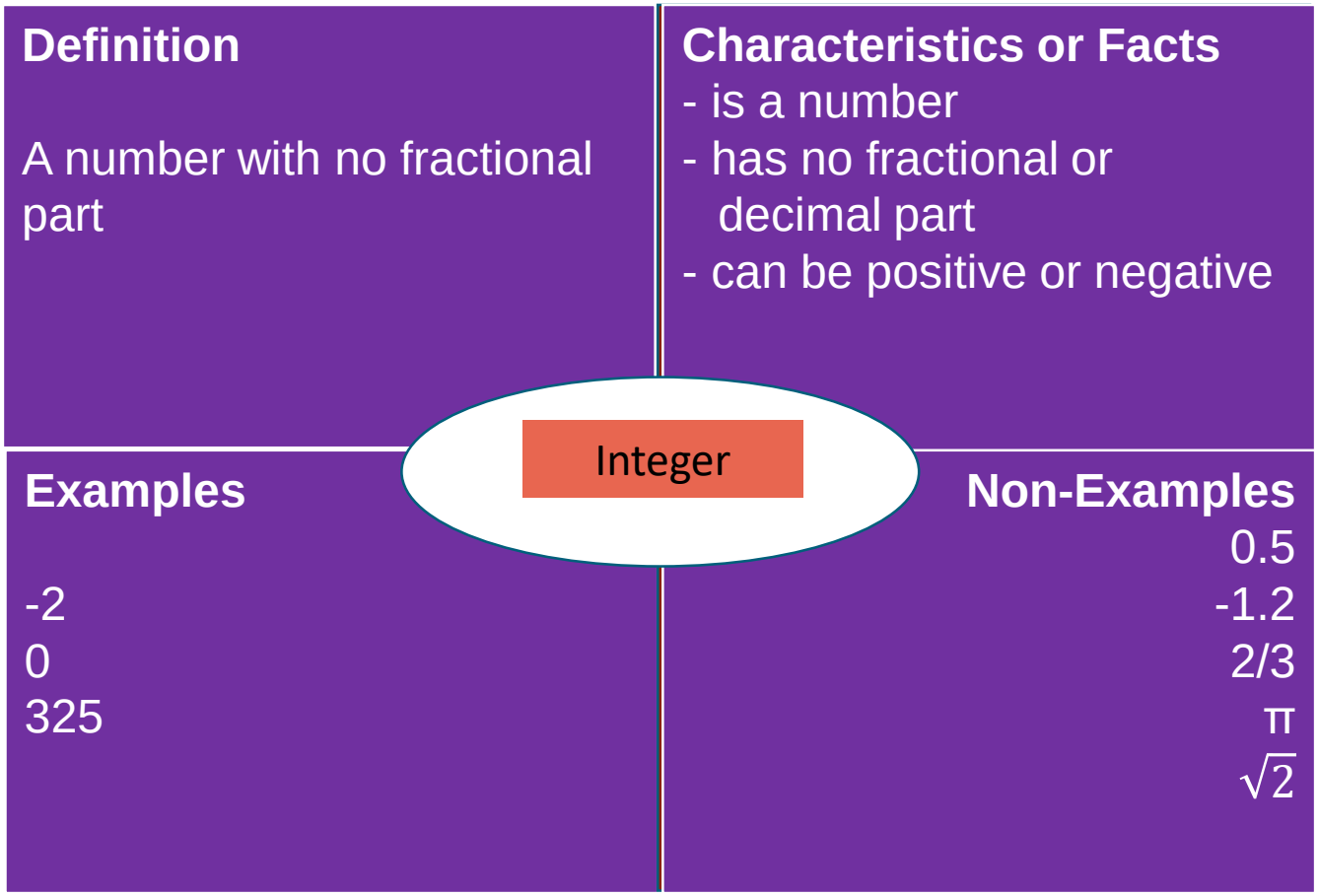
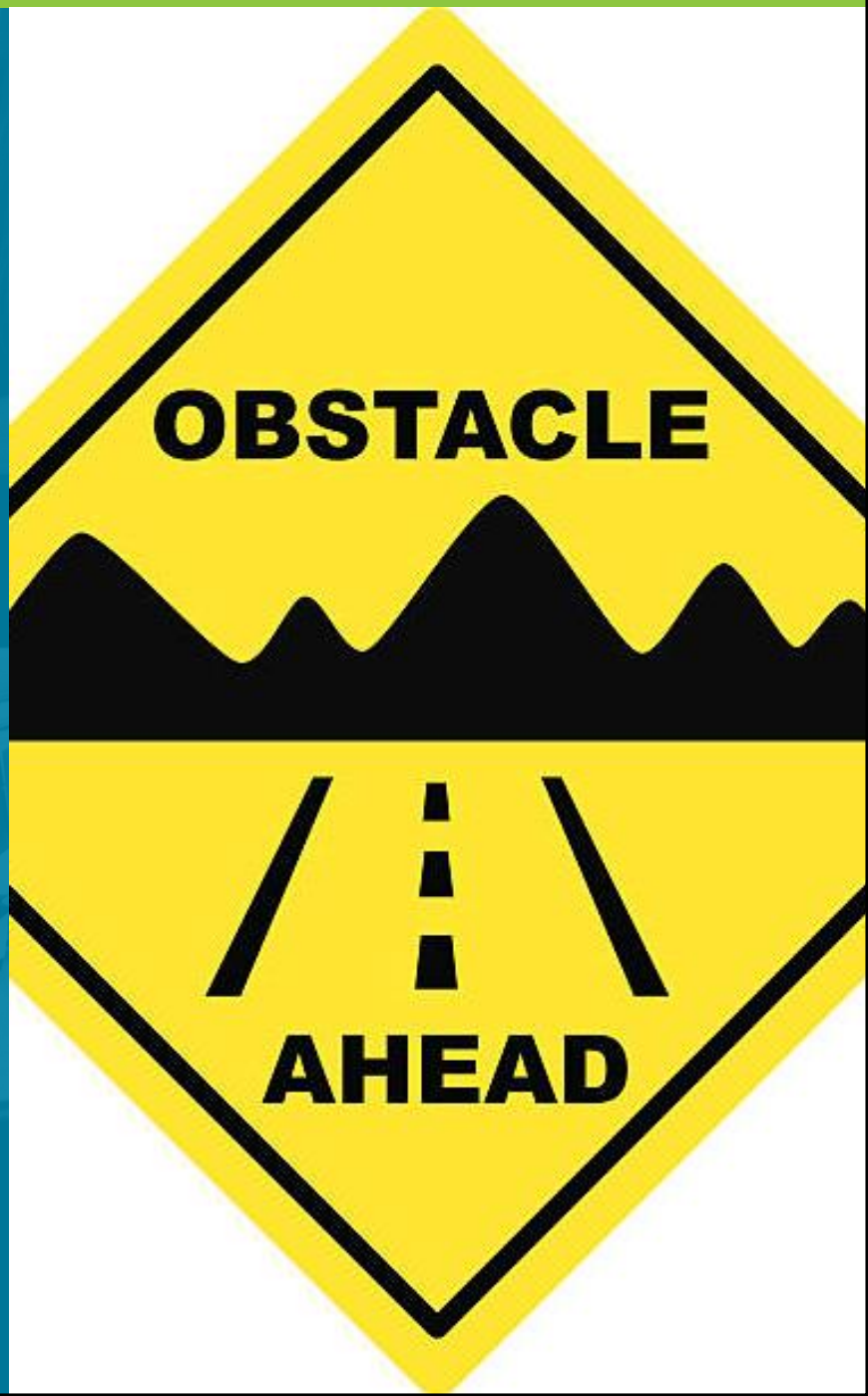
What is it?



Frayer Model – (Barton and Heidema, 2002)

Advice

Watch for Obstacles and Opportunities



Math Misconceptions

1. A number with three digits is always bigger than one with two

2. When you multiply two numbers together, the answer is always bigger than both the original numbers

3. Which fraction is bigger: 1/3 or 1/6?

4. Common regular shapes aren't recognized for what they are unless they're upright

5. The diagonal of a square is the same length as the side?

Time to Test Your Math Fluency

Mathematics Test

In the following simple math problems, a plus (+) sign means to multiply, a divide (÷) sign means to add, a minus (–) sign means to divide, and a times (×) sign means to subtract. Complete the problems.

17 x 2 =	8 + 2 =
14 ÷ 7=	15 x 3
8 + 2 =	14 – 7 =
9 + 11 =	6 x 5 =
4 x 3 =	8 + 3 =
6 ÷ 2 =	7 x 2 =
9 – 3 =	9 + 2 =
7 x 4 =	8 – 4 =
4 + 4 =	9 + 6 =
8 – 4 =	1 ÷ 1 =
12 x 2 =	8 x 7 =
20 – 1 =	13 – 1 =
9 – 1 =	16 – 4 =
5 + 6 =	9 x 2 =
2 x 1 =	9 ÷ 9 =

Misconceptions about Order of Operations

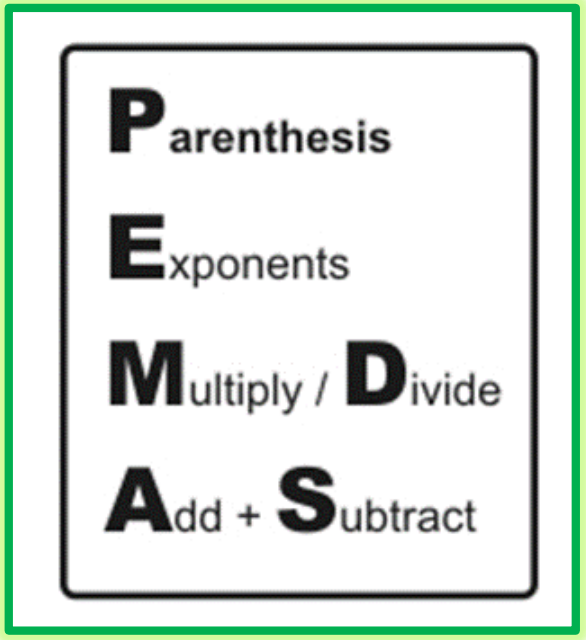
Misconception 1 - All multiplication should happen before division.

Incorrect	Correct
$12 \div 3 \times 4$	$12 \div 3 \times 4$
$12 \div 12$	4×4
1	16

Misconception 2 – All addition comes before subtraction.

Incorrect	Correct
$4+10-5+8$	$4+10-5+8$
$14-13$	$14-5+8$
1	$9+8$
	17

GROUPINGS ( ) { } [ ]
EXPONENTS N^2
MULTIPLY/DIVIDE ÷/×
(LEFT TO RIGHT)
SUBTRACT/ADD +/–
(LEFT TO RIGHT)



Advice

Reinforce the Basics

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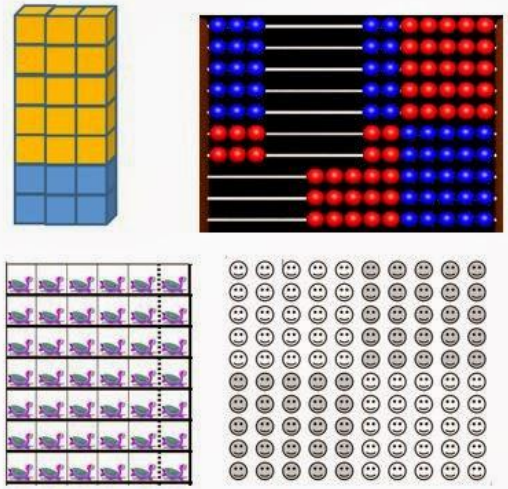
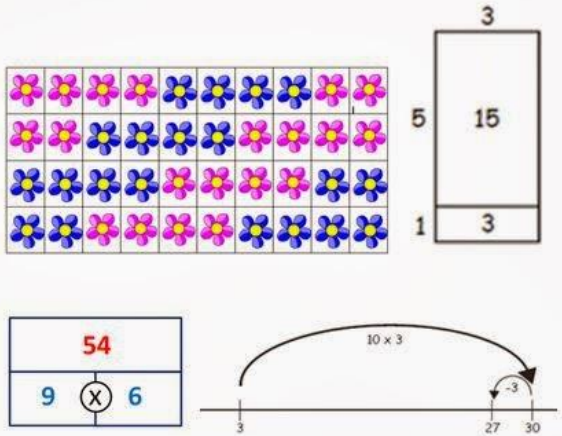
C-R-A – Essential for Understanding

Concrete	Representational	Abstract
Students manipulate hands-on, concrete materials	Students draw and observe diagrams, or watch the teacher touching and moving hands-on materials	Numbers and mathematical symbols
		x 4 Patterns: 4, 8, 12, 16, 20; 24, 28, 32, 36, 40 8 x 5 (4 x 2) x 5 4 x (2 x 5) 4 x 10 40 45 ÷ 5 (50-5) ÷ 5 (50÷5) - (5÷5) 10-1 9

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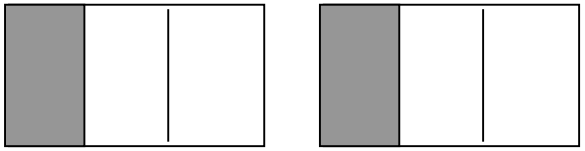
ROSE IS ROSE

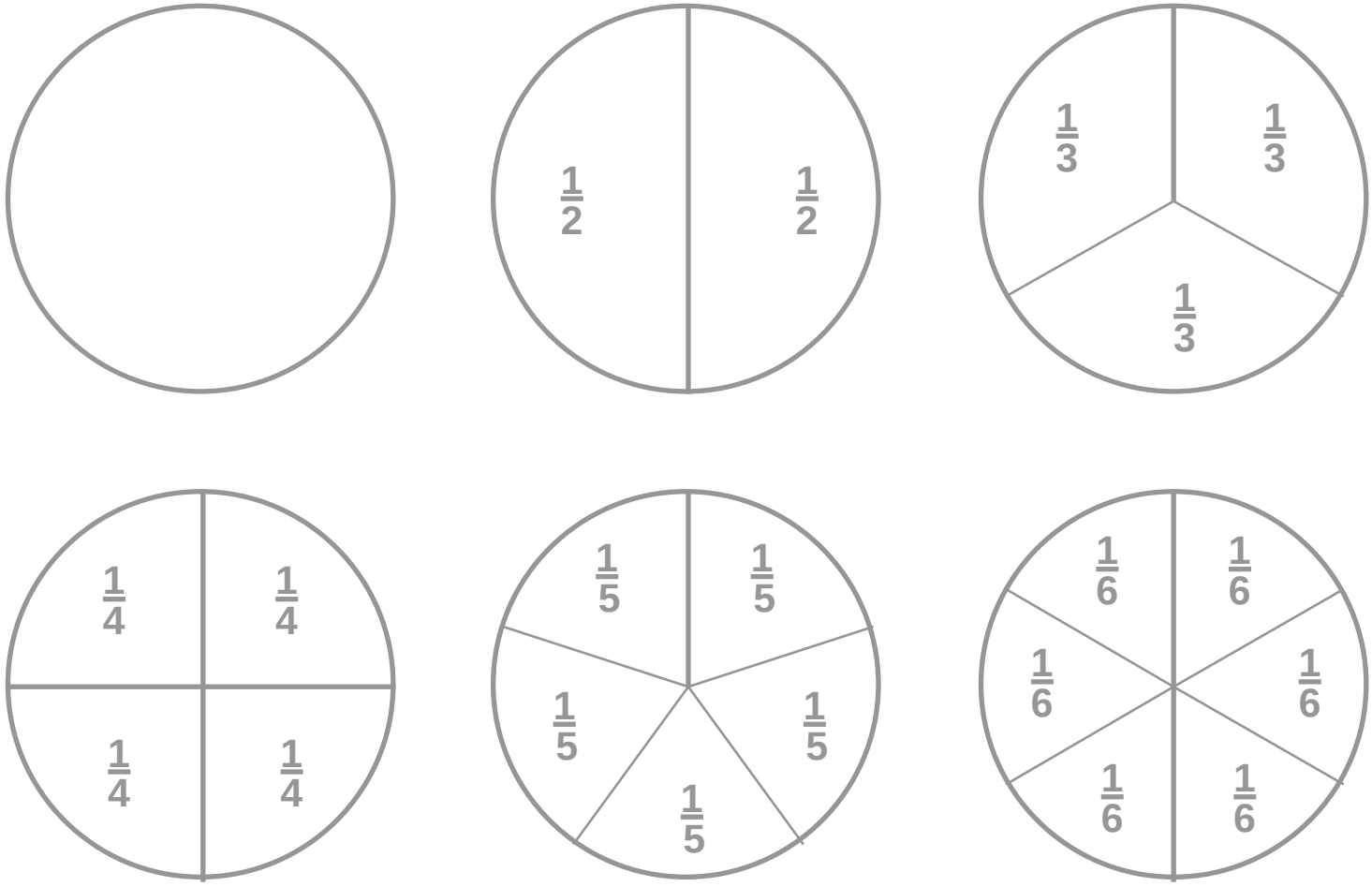
Number Operations and Number Sense



Teaching Fractions

- Let students use physical materials to **create** fractional amounts (draw, fold, cut, shade) to explore and develop concepts
- Use fraction words: two-*thirds of a candy bar, a third + a third*
- Relate unknown fractions to well known fractions, such as 1/2 or 1/4:
  - *It's more than a fourth, but less than a half.*
  - *It's smaller than a quarter*
- Use language that emphasizes ***relationship*** of fractional quantity to unit instead of *number* of pieces
  - ***"How many of this piece would fit into the whole candy bar?"*** instead of *"How many pieces is the candy bar cut into?"*
- Relate fractions to real-life entities, such as money

"Pie" Model



Try to compare 4/5 and 5/6 with this model.

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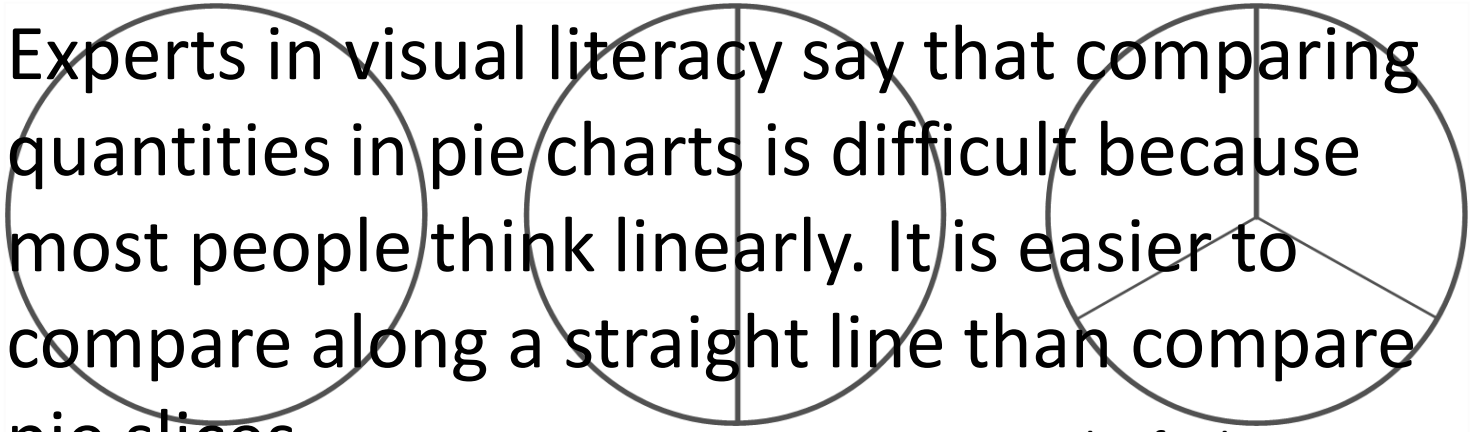
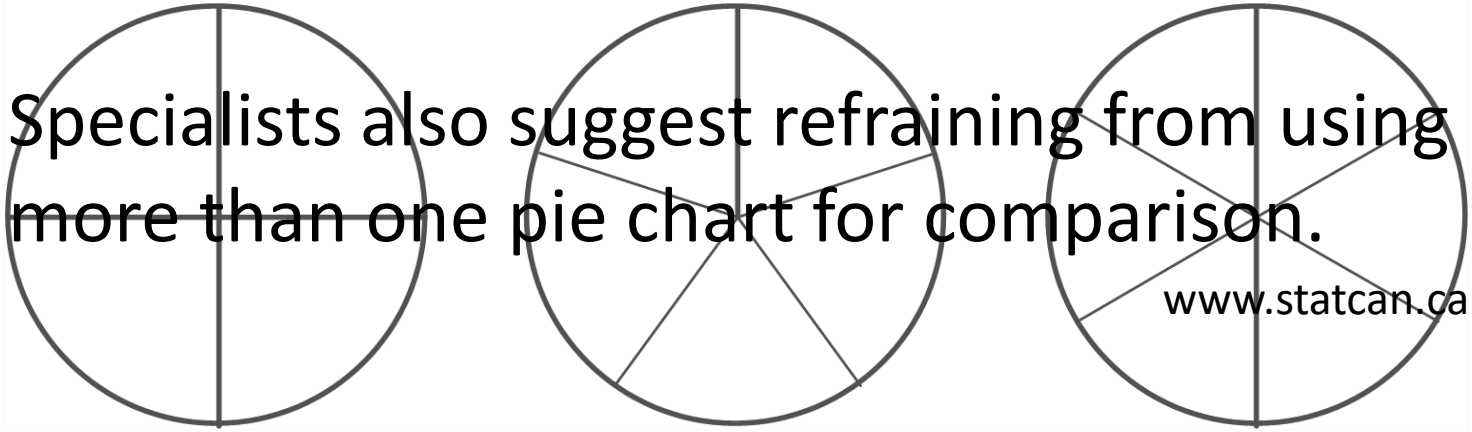
"Pie" Model



Experts in visual literacy say that comparing quantities in pie charts is difficult because most people think linearly. It is easier to compare along a straight line than compare pie slices.

askoxford.com



Specialists also suggest refraining from using more than one pie chart for comparison.

www.statcan.ca

Even adults have difficulty with pie charts.

Fraction Tiles

1									
$\frac{1}{2}$									$\frac{1}{2}$
$\frac{1}{3}$								$\frac{1}{3}$	
$\frac{1}{4}$							$\frac{1}{4}$		
$\frac{1}{5}$						$\frac{1}{5}$			
$\frac{1}{6}$					$\frac{1}{6}$				
$\frac{1}{7}$				$\frac{1}{7}$					
$\frac{1}{8}$			$\frac{1}{8}$						
$\frac{1}{9}$		$\frac{1}{9}$							
$\frac{1}{10}$	$\frac{1}{10}$								

A linear model gives an overview and shows relationships.

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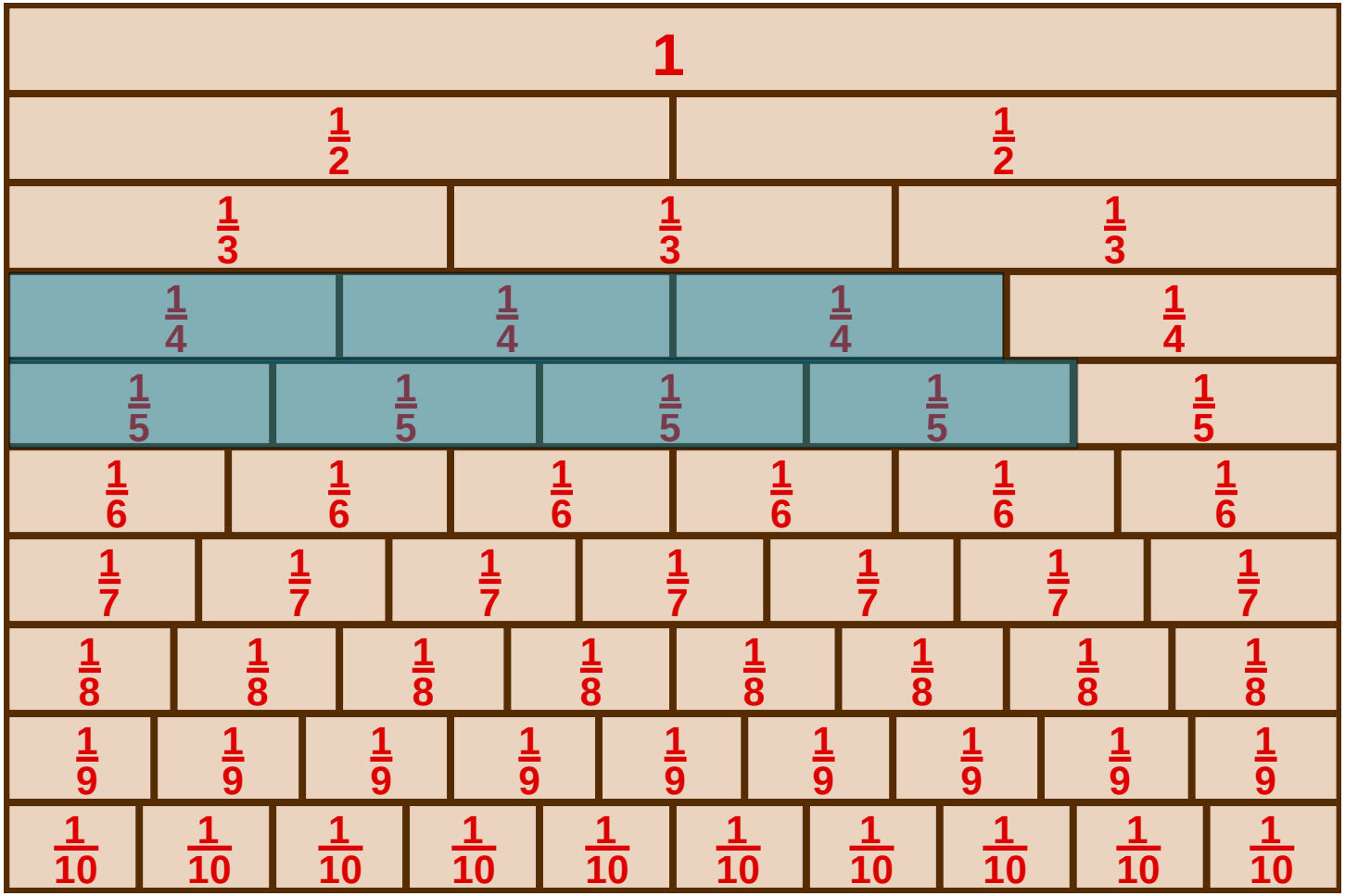
Fraction Chart



Which is more, 3/4 or 4/5?

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Simplify Fractions

1	2	3	4	5	6	7	8	9	10
2	4	6	8	10	12	14	16	18	20
3	6	9	12	15	18	21	24	27	30
4	8	12	16	20	24	28	32	36	40
5	10	15	20	25	30	35	40	45	50
6	12	18	24	30	36	42	48	54	60
7	14	21	28	35	42	49	56	63	70
8	16	24	32	40	48	56	64	72	80
9	18	27	36	45	54	63	72	81	90
10	20	30	40	50	60	70	80	90	100

21
28
45
72

The fraction 4/8 can be reduced on the multiplication table as 1/2.

Squares & Square Roots

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12						
3	6	9	12	15	18						
4	8	12	16	20	24						
5	10	15	20	25	30	35		45	50	55	60
6	12	18	24	30	36	4	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

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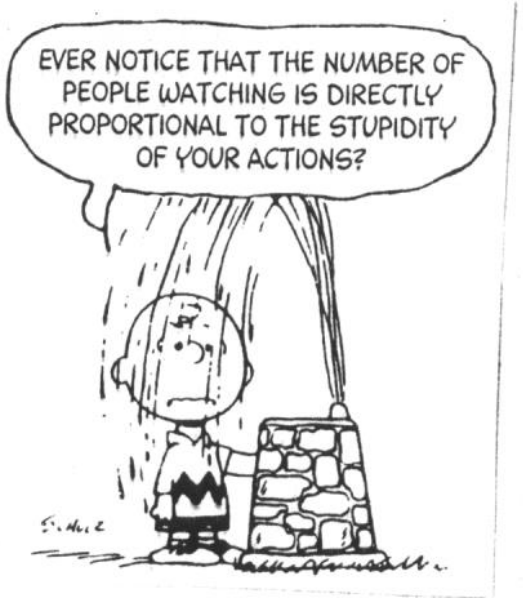
Percents, Ratios, and Proportions – What's the Problem?

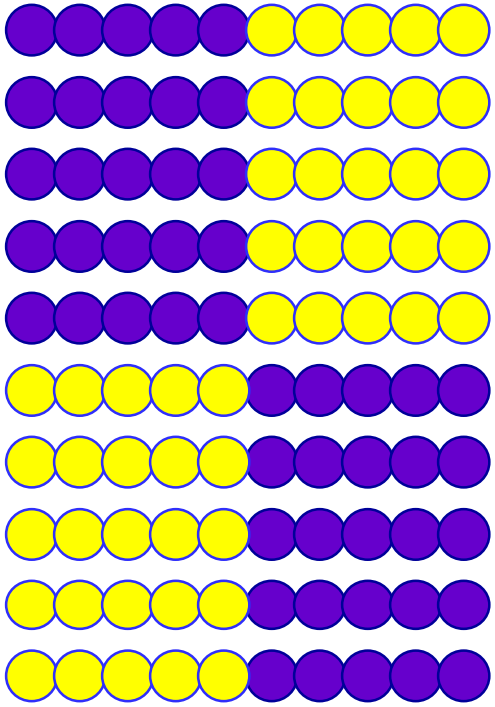
- Percent means "out of 100"

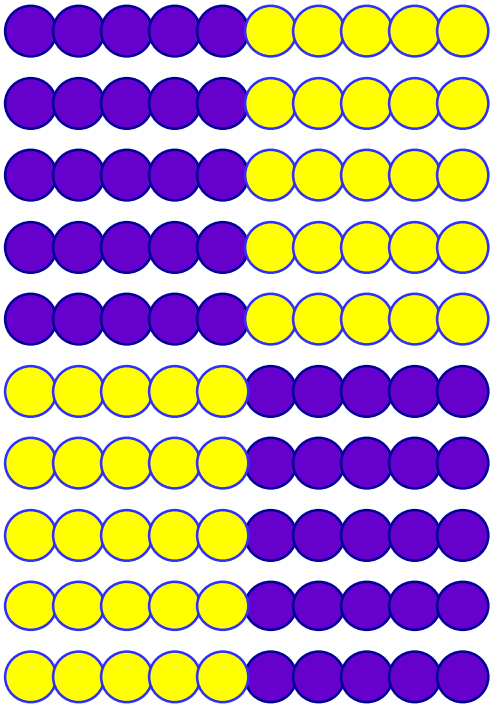
4:3

- Ratio describes the part to part relationship
- Proportion describes the part to whole relationship



Percents





Percent means per hundred or out of 100.

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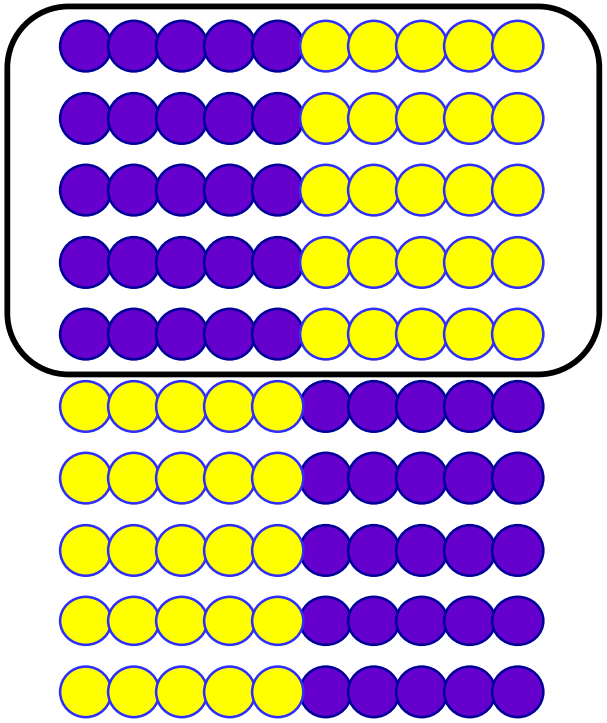
Percents



$\frac{1}{2}$ of 100 = $\frac{50}{100}$ = 50%

Percent means per hundred or out of 100.

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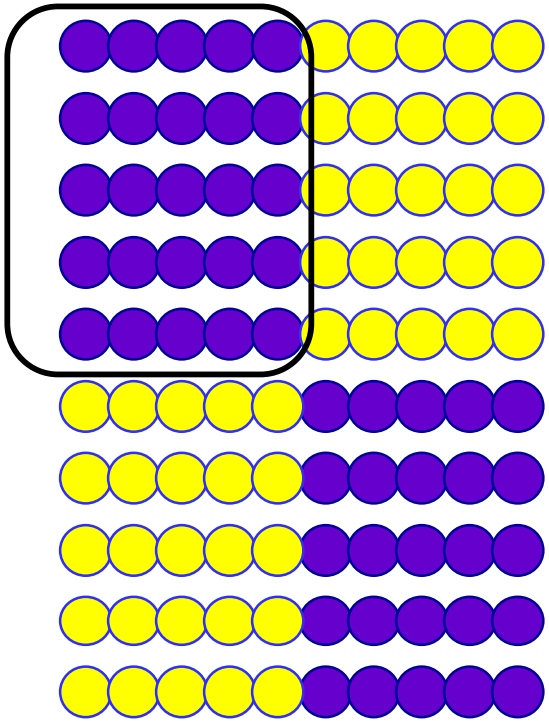
Percents



$\frac{1}{4}$ of 100 = $\frac{25}{100}$ = 25%

Percent means per hundred or out of 100.

Number Operations and Number Sense

Quick Math

A toaster that usually sells for $40 is on sale for 5% off. If 5% sales tax is then added to the sales price, what is the amount you would pay for the toaster?

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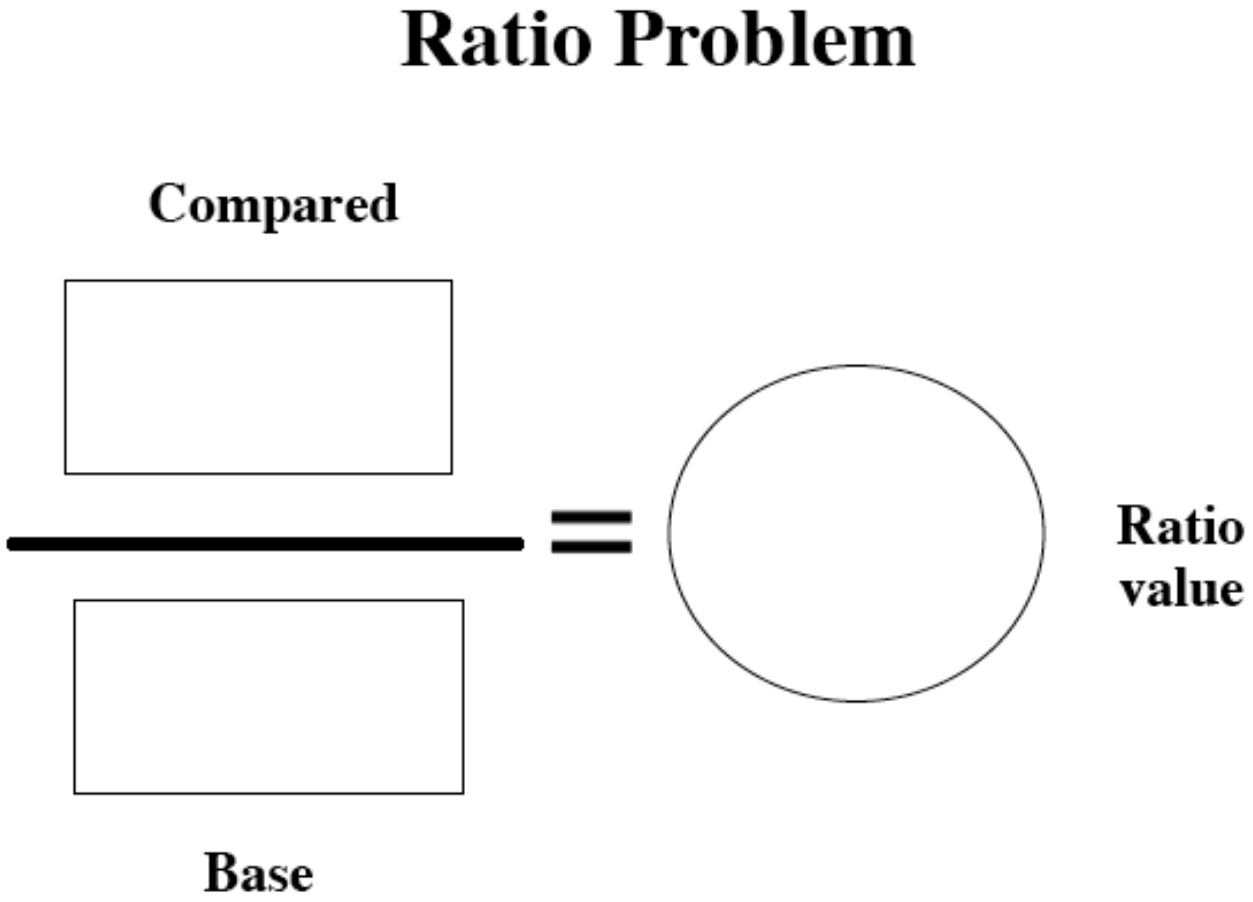
Ratio and Proportion – Use Graphic Organizers



Provide a "Concrete" Example

Ratios can have **more than two numbers**!

For example concrete is made by mixing cement, sand, stones and water.

A typical mix of cement, sand and stones is written as a ratio, such as 1:2:6.

We can multiply all values by the same amount and still have the same ratio.

10:20:60 is the same as 1:2:6

So when we use 10 buckets of cement, we should use 20 of sand and 60 of stones.

https://www.mathsisfun.com/algebra/proportions.html

Provide a "Concrete" Example

Example: you have just put 12 buckets of stones into a mixer, how much cement and how much sand should you add to make a 1:2:6 mix?

Let us lay it out in a table to make it clearer:

	Cement	Sand	Stones
Ratio Needed:	1	2	6
You Have:			12

You have 12 buckets of stones but the ratio says 6.

That is OK, you simply have twice as many stones as the number in the ratio ... so you need twice as much of **everything** to keep the ratio.

Here is the solution:

	Cement	Sand	Stones
Ratio Needed:	1	2	6
You Have:	2	4	12

And the ratio 2:4:12 is the same as 1:2:6 (because they show the same ***relative*** sizes)

So the answer is: add 2 buckets of Cement and 4 buckets of Sand. *(You will also need water and a lot of stirring....)*

https://www.mathsisfun.com/algebra/proportions.html

And… Don't Forget Probability!

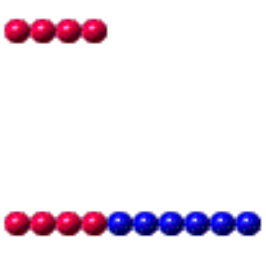
Back to Basics

To find a basic probability with all outcomes equally likely, we use a fraction:

$$\frac{\text{number of favorable outcomes}}{\text{total number of possible outcomes}}$$

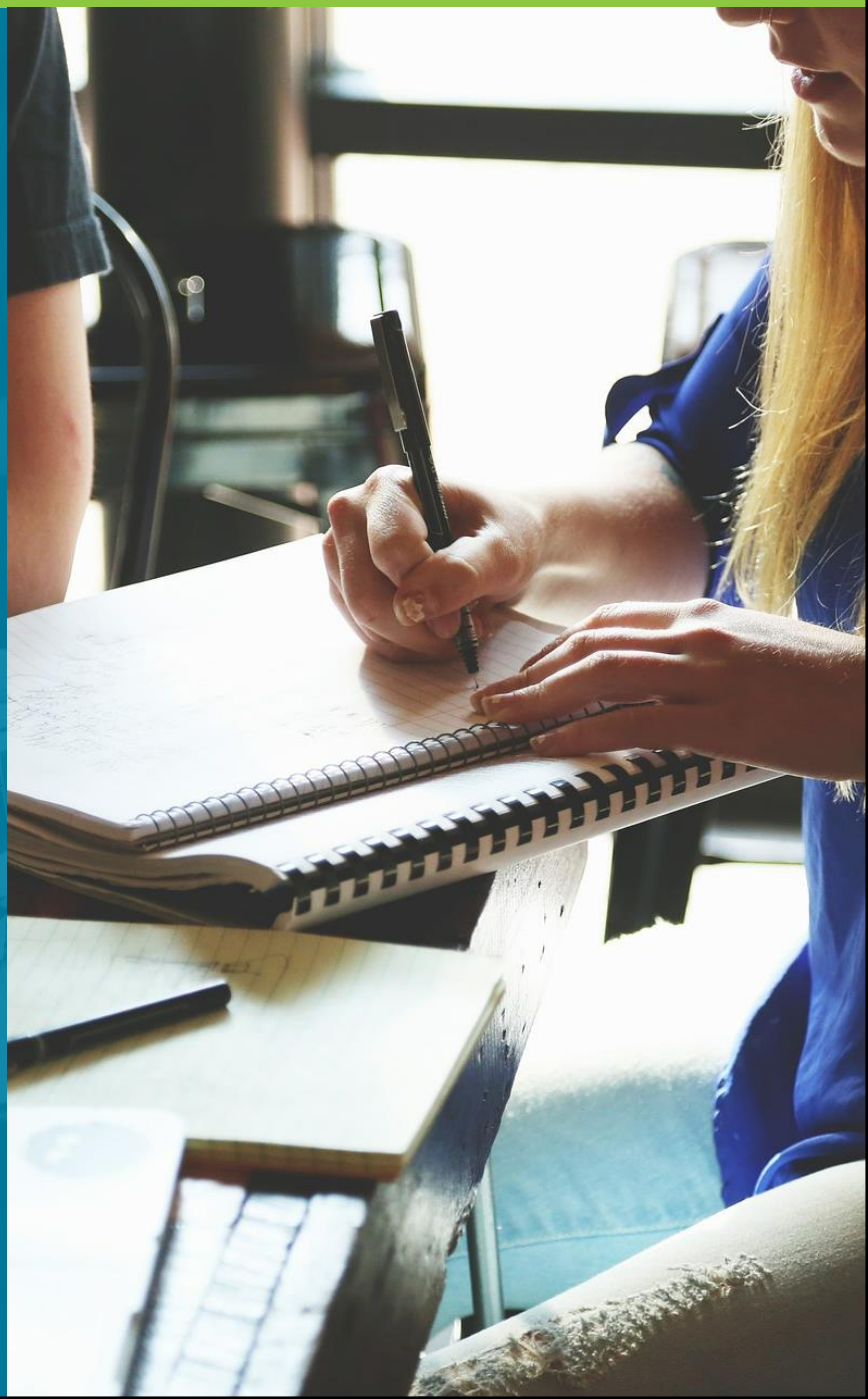
One event, all outcomes equally likely 

What is the chance that you will draw a red marble?

$$\frac{\text{number of red marbles}}{\text{total marbles in jar}} = \frac{4}{10}$$ 

4/10 = 2/5 = **40%**

Getting Down to Basics with Algebraic Reasoning



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What About Algebra?

Key Differences Between Likely to Pass and the Red Zone

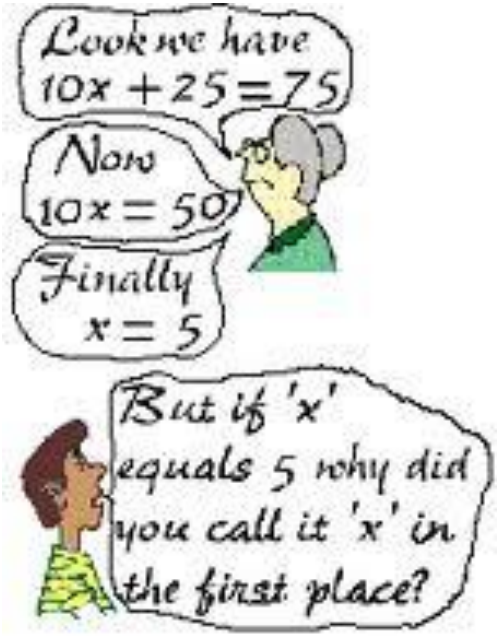
Students

- Have a much smaller skill repertoire, e.g.
  - Tend to be able to work with equalities but not inequalities
  - Tend to have very weak graphing skills
- Are far less able to apply math skills to real-world situations or interpret real-world skills mathematically
- Are far less consistent in their performance (likely to be “hit or miss”)

Remember . . .

- Arithmetic is doing something to numbers to get an answer.

- Algebra is exploring the relationships between numbers.



Symbolic Notation

Sign	Arithmetic	Algebra
= (equal)	. . . And the answer is	Equivalence between two quantities
+	Addition operation	Positive number
-	Subtraction operation	Negative number

Algebraic Misconceptions

1) $a + a + a + a = \mathbf{4a}$

2) $3a \times 2b = \mathbf{5ab}$

3) $c \times c = \mathbf{2c}$

4) $5y - y = \mathbf{5}$

5) $3(2k + 3) = \mathbf{6k + 6}$

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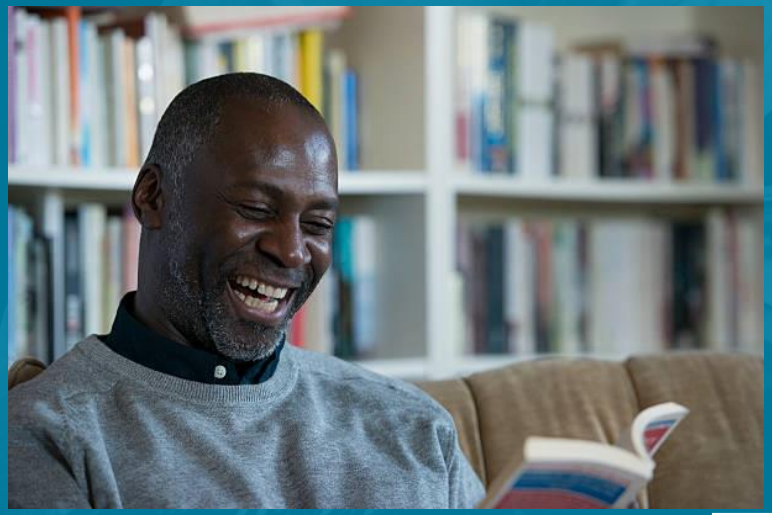
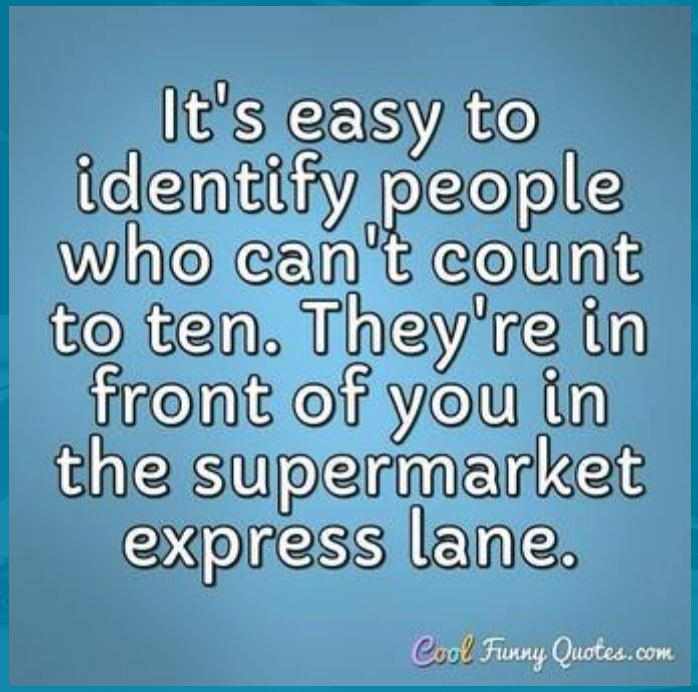
Have Fun!





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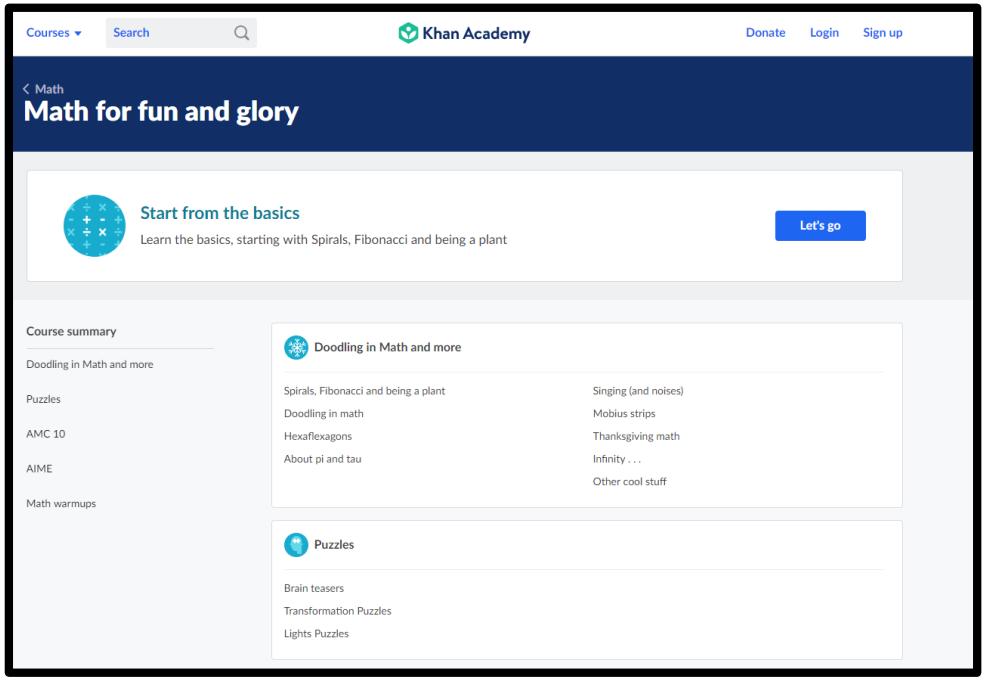
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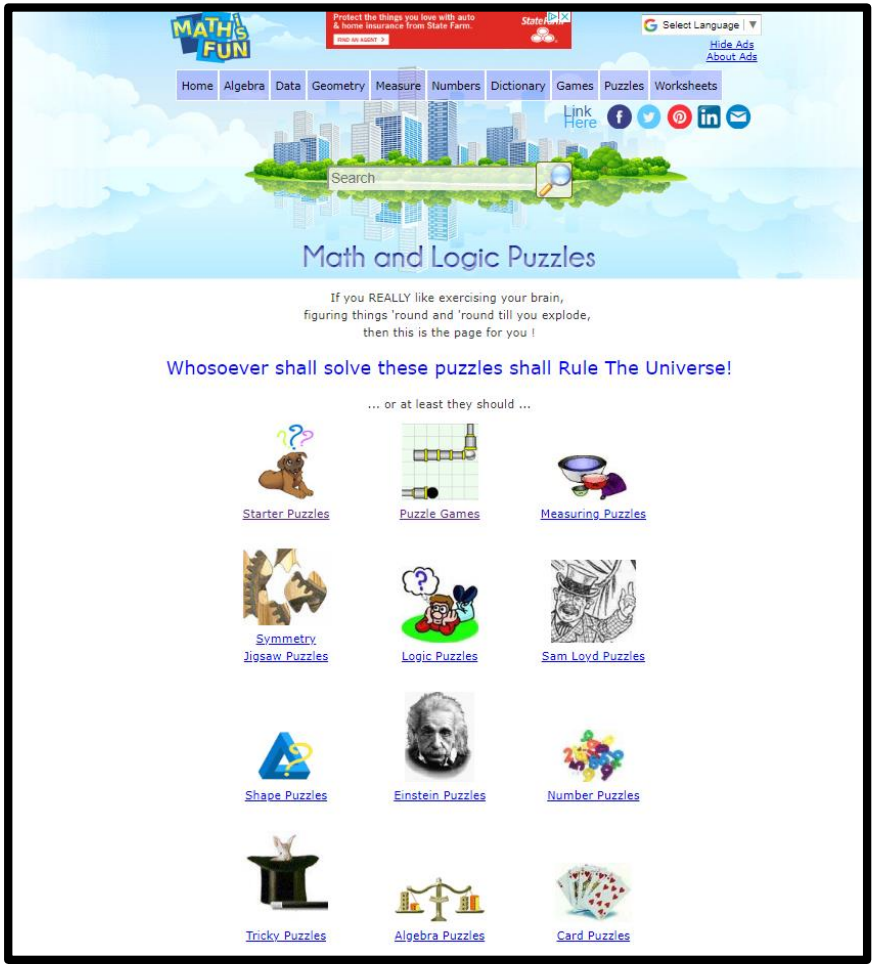
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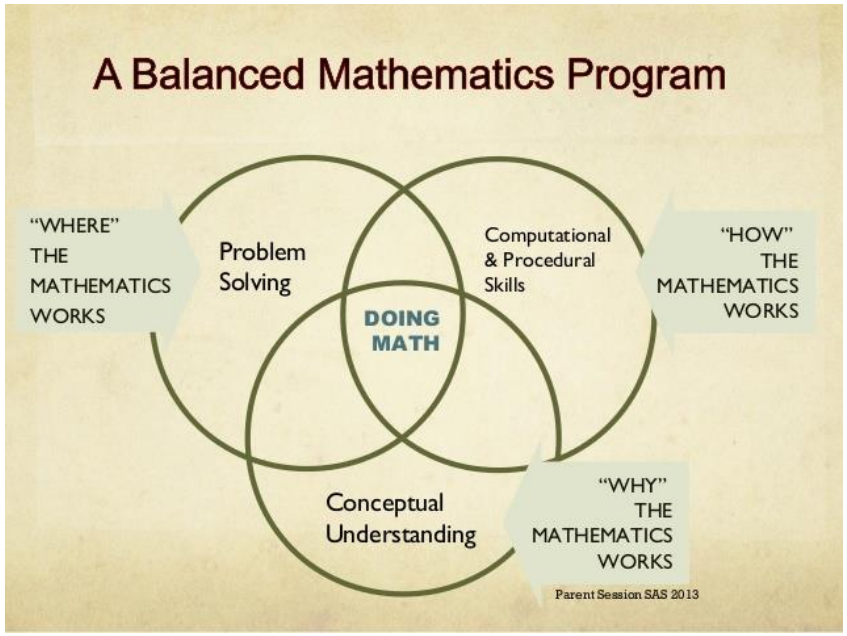
Our Students Need…



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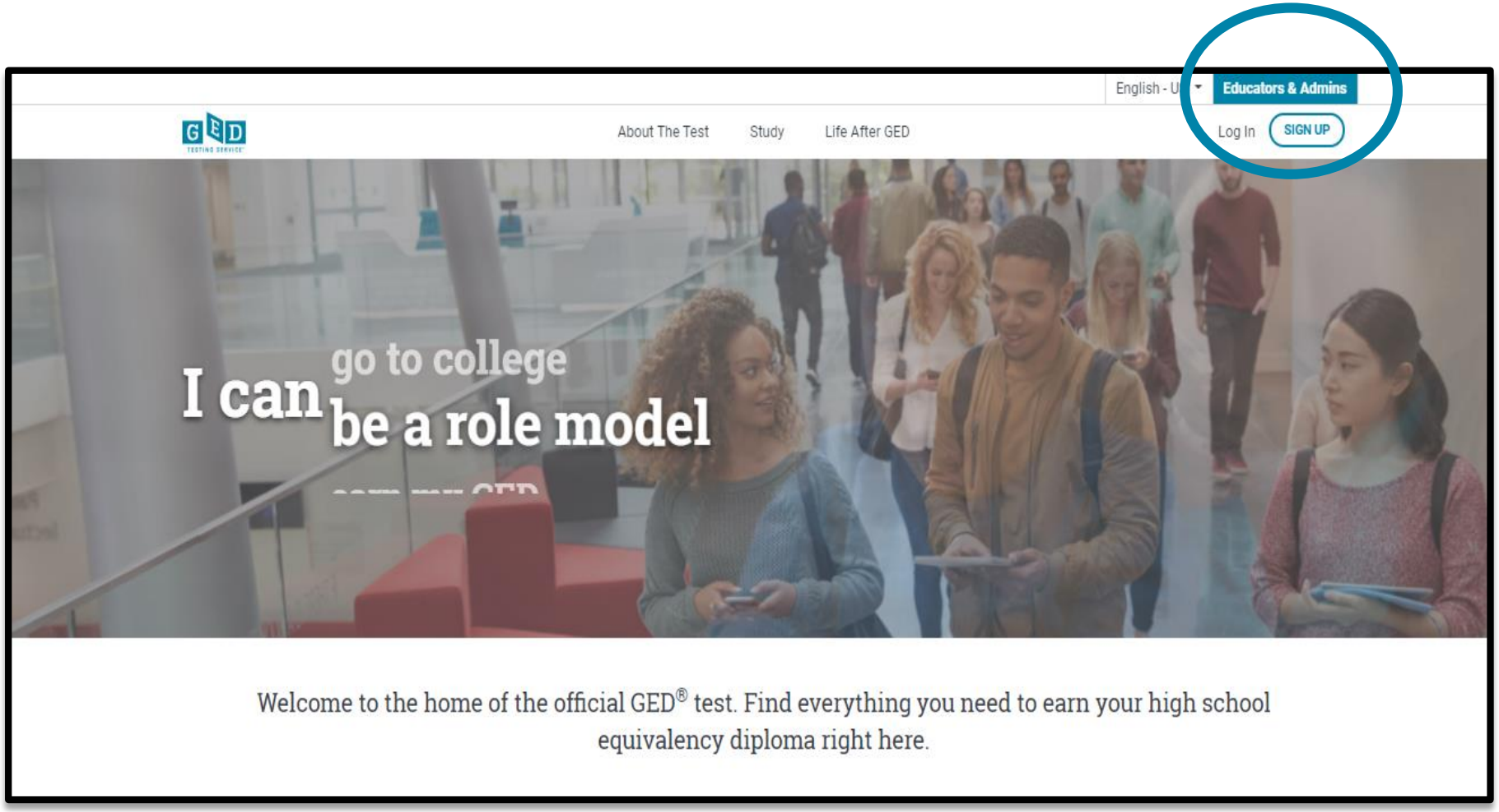

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